A Community Energy Management Program Report

Energy
Ontario

HIGH EFFICIENCY RESIDENTIAL

CONDENSING GAS FURNACE

FIELD EVALUATION

"INSTALLATION REPORT"

Undertaken jointly by the Ontario
Ministries of Municipal Affairs
and Housing and Energy and
Consumers' Gas Company Ltd. under the
Community Energy Management Program
(C.E.M.P.)

Prepared For
Ontario Ministry of Municipal Affairs and Housing
Technical Services Division
Research & Development Section
By
The Consumers' Gas Company Ltd.
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1.0 INTRODUCTION

The Consumers' Gas Company and the Ontario Ministry of Municipal Affairs and Housing share a mutual interest in the area of energy conserving gas appliances.

Appliances which are presently making an impact on the market are the High Efficiency Residential Condensing Gas Furnaces. These new products have great potential for widespread application. For these reasons it was decided that a field evaluation would determine performance, serviceability and actual energy savings in a realistic test situation.

The Consumers' Gas Company and The Ontario Ministry of Municipal Affairs and Housing decided to field evaluate,initally, one model line of high efficiency appliance on a 50:50 funding basis.

Two similar model High Efficiency Condensing Gas furnaces are presently installed. One in a test site in Scarborough, the other in Markham. Both units are operating currently. Readings are taken on a daily basis.

This report contains demographic data on the test sites, information on the installations, installed instrumentation and a general outline on the evaluation procedure.

2.0 THE HIGH EFFICIENCY CONDENSING GAS FURNACE

The High Efficiency gas furnaces were developed and manufactured in Ontario, Canada.

This type of furnace differs from a conventional residential gas furnace in that a greater amount of heat is extracted from the combustion products. A third heat exchanger, located in the supply air stream, condenses out moisture from the stack gas. The unit is wall vented through PVC piping. Exhaust temperatures are in the 40 to 48°C range.

Due to the greater heat exchange, higher efficiencies can be expected. The manufacturer claims 93% efficiency.

Another advantage of the unit is the elimination of a conventional flue. This arrangement reduces transportation losses. While convection losses are very site specific, this arrangement can provide a significant reduction in fuel consumption.

The furnace comes with a $^1/_3$ H.P. motor. All pressure and limit switches are preset at the factory.

The unit works on the spark to pilot principal. An electronic ignition lights the pilot. The pilot then lights the burner as in a conventional furnace.

Condensate is removed from the exhaust pipe by a plastic drain. A treatment bottle is an option with these units.

The overall large size of the unit is a problem. At one installation the door jamb had to be removed to install the unit. At the other, the unit had to be taken apart and reassembled on site. Overall nominal dimensions are:

Unit	Width	Depth	Height	
Model A	80	75	140	(in cms.)
Model B	91.5	71.5	140	

3.0 EVALUATION PHILOSOPHY

The energy performance of the High Efficiency Condensing units will be evaluated in the following manner.

Since the electric furnaces can be assumed to be 100% efficient at site, a direct heating load comparison can be used to assign a seasonal energy efficiency figure to the furnaces at each site.

The analytical method of evaluation is a modified form of the preferred method, derived by the Institute of Gas Technology, in Chicago.

From the daily readings an energy input (per 24 hours) can be obtained. This figure is also the rate of heat loss. When plotted against the mean outside temperature (or degree days per day) the expected curve is linear and a standard regression can be used to determine slope (K) and intercept (Balance point temperature, Tb).

This is based on the observation that the rate of heat loss increases as the difference between inside and outside temperature increases.

A reduction in the slope (K) can be related to an increased efficiency of energy use.

4.0 INSTALLATIONS

Two different sized and styled homes were selected for field evaluation of the Condensing furnaces. The Markham site has a heated area of 284 square meters and is a bungalow. The Scarborough site is a semi-detached two storey home, with a floor area of 126 square meters.

Both sites are presently operated on a daily flip flop basis, as this produces the most accurate indication of performance.

For installation of both sites, the same contractor was used. Installations at both sites are neat and compact.

4.1 Thermostatic Control

At the Markham site the original Honeywell T87 thermostat was used to control both furnaces through a Double Pole Double Throw (DPDT) blade switch.

Household temperature is maintained at 18°C.

Preliminary observations show that the electric furnace cycles more frequently, at about twice the rate of the Condensing furnace. This is due to a difference in heat anticipation by the thermostat with each furnace and due also to the long running cycle of the Condensing furnace.

At the Scarborough site a White Rodgers "Comfort Set" automatic setback thermostat was installed to control both furnaces through a DPDT blade switch.

At the high setting, temperature is maintained at 22°C, this is between the hours of 5:45 and 8:30 and between 15:30 and 23:00.

At the low, or nighttime setting, 20°C is maintained.

4.2 Humidity Control

At both sites, standard 24 VAC operation humidifiers are installed and controlled by Honeywell Humidostats. Humidity is maintained at ± 3% R.H. of the set degree which is 47% R.H. and 30% R.H. for the Markham and Scarborough sites respectively.

4.3 Instrumentation

Monitoring equipment was installed at each site. It includes:

1) Hidy Brown Degree Day Recorders.
   Records fahrenheit degree day experienced at the site, read daily.

2) Ambient Temperature Recorders
   Bristol instruments
   7 day electric chart drive, changed weekly.

3) Special 1 cubic foot digital index Gas Submeters
   Canadian Meter Co.
   Installed on gas line to Condensing furnace, read daily.

4) 2-200 amp standard dial Kwh Meters
   Sangamo Electric Ltd.
   Installed on power line to electric furnace.
   Reads total electric consumption by electric furnace, read daily.

5) Digital on time Meters reading to tenths of an hour.
   24 VAC operation through transformer on blower motor, read daily.

6) Event Counters
   Sonotec Ltd. Special
   24 VAC operation through transformer on blower motor.
   Counts number of times the blower motor comes on, read daily.

7) 30cm Stem Duct Thermometers
H.O. Trerice Co.
Installed in supply and return ducts, read daily.

8) Chart Drive Thermohumidograph
Bristol Instruments Co.
Installed temporarily to monitor household temperature, humidity, events and thermostat operation.

5.0 SCARBOROUGH TEST SITE

The test site in Scarborough is a semi-detached home of brick construction. It is a two storey house of 126 square meters living area. The house is of average tightness. All windows are stormed and screened.

The previous heating system was a Forced Air oil furnace utilizing the same duct work. This furnace was rated at 3.86 litres/minute input (26.4 kw).

A heat loss study was conducted to estimate the necessary furnace sizing, see Figures 1 and 2. The heat loss at this site was 14.45 kw.

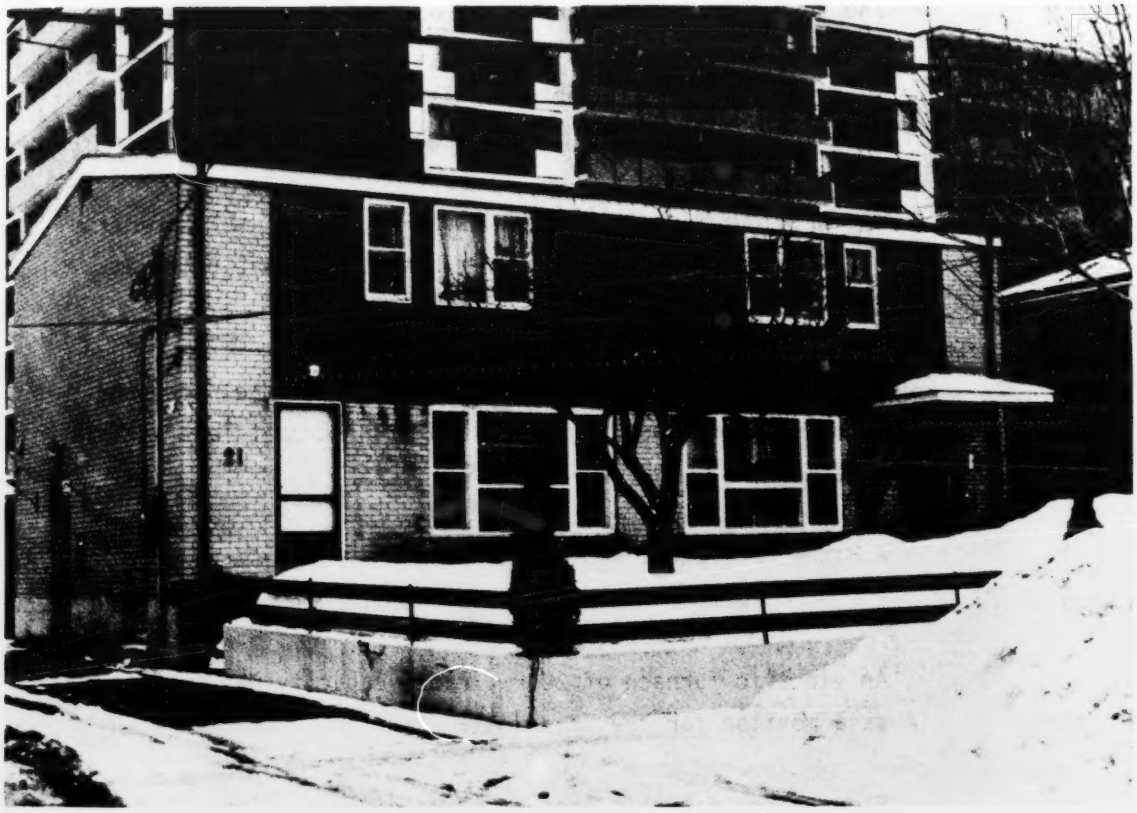
A High Efficiency Condensing furnace with an input of 17.58 kw rated capacity was selected to be tested at this site.

An electric furnace of 20 kw, rated capacity was selected as a monitor for the gas unit.

Floor plans for this test site are given as Figure 3.

This test site is equipped with a gas water heater with a conventional flue stack.

ILLUSTRATION 1



SCARBOROUGH SITE

HOMEOWNER QUESTIONNAIRE

TABLE I

GENERAL INFORMATION

Name of occupant Company Employee

Installation address Scarborough

Single Family Residence? Yes Multiple? _____

Approx. age of structure 25 years How long have you resided? 10

No. of occupants 3 Adults 2 How many are employed 2

If two or more, which hours 7am to 5pm and 8am to 5pm

What indoor temperatures do you maintain:

While at work 20°C Hours 8am to 5pm

Daytime 22°C Hours 5pm to 11pm & 6am to 8am

Nighttime 20°C Hours 11pm to 6am

STRUCTURE

Do you have a basement Yes Is it heated Yes

Number of stories 2

Type of construction (Brick or frame) Brick

Does it have storm windows Yes Storm doors Yes

Is it insulated Yes Was any insulation installed recentJy Yes

If so, when 1978?79 Where, and thickness Attic Type Blow in

In your opinion, is building of tight construction Yes

No. of basement windows 2 Do they close tightly Yes

Is the door to the basement normally closed No

No. of exhaust Fans: Kitchen 1 Bathroom 1 Other -

Where is thermostat located (room) Dining Inside or Outside wall Inside

Does this house have a fireplace No Does it have a good damper ?

How often is it used? _____

Chimney height _____ No. of flues _____ Internal dia. of each flue _____

No. of openings in chimney _____

Does it have a cleanout door inside or outside _____

APPLIANCES

Does this residence have a gas light No

Input or number of mantles _____

Does this residence have an electric or gas range Electric

If gas: Type - Location -

If more than one, type _____ Location _____

Does this residence have a gas grill Yes

Hourly inputs 11.72 kw How often is it used 3 or 4 times a week

Does this residence have a gas or electric clothes dryer Electric

If gas: Location _____ Vented to outdoors? _____

Size of vent pipe _____ Hourly input _____

How often is it used _____

Does this residence have a gas fired water heater Yes

Storage capacity 180 L Hourly input ? _____

Size of flue pipe 102 mm Does this pipe connect to the same chimney as the heating system. Yes

Does this residence have air conditioning Yes

Central _____ Window units X How many? 1

HEATING SYSTEM

Present Furnace.

Trade Name Gurney Oil

Model F33-Code 955

Manufacturer Gurney

Rated Input 26.37 kw

Age 25 years

Type of Ignition Spark

Type of Venting 200mm E. Vent

Test Furnace.

Trade Name Clare Megasave I

Model HEG 60

Manufacturer Clare Brothers

Rated Input 17.58 kw

Age New

Type of Ignition Spark to Pilot

Type of Venting P.V.C. Pipe

Figure I - Heat Loss Study - Scarboro

copy for:-

ONTARIO ELECTRICAL LEAGUE

heating and cooling installation record

note: this is not a contract: any amounts stated herein are estimates only and are subject to change without notice.

☐ new ☑ conversion	specification for ☑ heating ☐ cooling	date SEPT 29/81
submitted for MR. L. MYERS	submitted by CONSUMERS GAS CO.	
location of installation 31 CHELWOOD RD SCARBOROUGH	address 500 CONSUMERS RD. NORTH YORK	phone number 492-5883
power supply authority SCARBOROUGH P.U.C.	address 1750 KINGSTON RD.	phone number 699-9611

estimated annual heating consumption Btu kwh	estimate based on details submitted and:-	heated area 1362 sq. ft.	cooled area sq. ft.	☐ to Ontario Building Code
annual heating cost $639 - $815 estimated at 3.45 c/kwh		degree days 7500	c factor 14.5 - 18.5	☑ other conditions list.
		inside design temp. heating 70°F cooling	outside design temp. heating -3°F cooling	

remarks

CEILING :- R28 INSULATION
WALLS :- SOLID MASONRY
BASMT WALL :- UNINSULATED
DOORS & WINDOWS :- STORMED, DOUBLE GLAZED

and ▶ heating-cooling each room to the following requirement note: shaded area for use of inspection only.

room or area name and identify carefully	cooling min. Btuh	heating min. watts or Btuh required	heating installed watts or Btuh	room or area name and identify carefully	cooling min. Btuh	heating min. watts required	heating installed watts or Btuh
1ST FLOOR		5503					
2ND. FLOOR		5225					
BASMT.		3641					

RE: THIS COPY FOR CUSTOMER

type of system ☐ cable ☐ hydronic ☐ baseboard ☐ heat pump ☐ central warm air ☐ other (state)	installed cooling capacity	totals ▶		14,449	as per O.B.C.

Notify power supply authority and the original calculator of changes in details submitted as they could affect heating consumption and installed capacity.

installed capacity approval	prepared by 123 C. CHARLESWORTH		reference C13-2249
inspected by	approved by MARCH 31, 1982		
date	inspection order no.	O.E.L. representative	

Figure 2 - Heat Loss Study - Scarboro

THE ONTARIO ELECTRICAL LEAGUE

1362 ft² 14,449 cu ft **HEAT LOAD CALCULATION WORK SHEET**

description		coefficient watts/btuh per sq. ft. per °F TD.	coefficient watts/btuh per sq. ft. for 75 °F TD.	room - 1st. FLOOR L 37.7' W 30' H 8' heat loss in watts/btuh	room - 2nd FLOOR L 37.7' W 30' H 7.5' heat loss in watts/btuh	room - L W H heat loss in watts/btuh	room - L W H heat loss in watts/btuh
gross outside wall				584 sq. ft.	476 sq. ft.	sq. ft.	sq. ft.
glass		0.15	11.3	93 sq. ft. 1051	46 sq. ft. 520	sq. ft.	sq. ft.
outside door		.079	5.9	42 sq. ft. 248	- sq. ft. -	sq. ft.	sq. ft.
net outside wall		.088	6.6	429 sq. ft. 2831	424 sq. ft. 2798	sq. ft.	sq. ft.
ceiling	R30	.016	1.2	1351 sq. ft. -	1351 sq. ft. 515	sq. ft.	sq. ft.
floor	joist	-	-	- sq. ft. -	- sq. ft. -	sq. ft.	sq. ft.
	slab	-	-	- lin. ft. -	- lin. ft. -	lin. ft.	lin. ft.
infiltration 1 AC/HR		.0053	0.4	3632 sq. ft. 1153	3105 sq. ft. 1362	sq. ft.	sq. ft.
calculated in -		☑ watts ☐ btuh		total 5585	total 5725	total	total

description		coefficient watts/btuh per sq. ft. per °F TD.	coefficient watts/btuh per sq. ft. for ..... °F TD.	room - L W H heat loss in watts/btuh	room - L W H heat loss in watts/btuh	room - L W H heat loss in watts/btuh	room - L W H heat loss in watts/btuh
gross outside wall				sq. ft.	sq. ft.	sq. ft.	sq. ft.
glass				sq. ft.	sq. ft.	sq. ft.	sq. ft.
outside door				sq. ft.	sq. ft.	sq. ft.	sq. ft.
net outside wall				sq. ft.	sq. ft.	sq. ft.	sq. ft.
ceiling				sq. ft.	sq. ft.	sq. ft.	sq. ft.
floor	joist			sq. ft.	sq. ft.	sq. ft.	sq. ft.
	slab			lin. ft.	lin. ft.	lin. ft.	lin. ft.
infiltration				sq. ft.	sq. ft.	sq. ft.	sq. ft.
calculated in -		☐ watts ☐ btuh		total	total	total	total

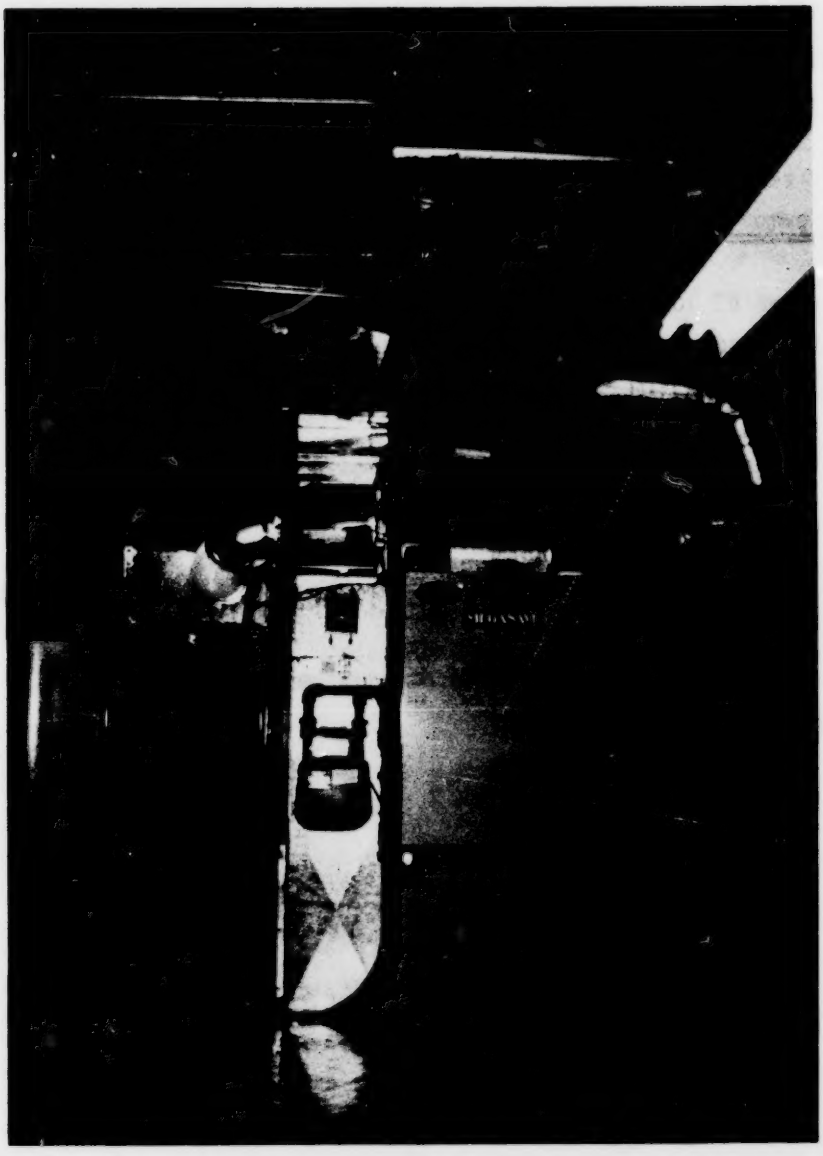
description		coefficient watts/btuh per sq. ft. per °F TD.	coefficient watts/btuh per sq. ft. for ..... °F TD.	room - L W H heat loss in watts/btuh	room - L W H heat loss in watts/btuh	room - L W H heat loss in watts/btuh	room L W H heat loss in watts/btuh
gross outside wall				sq. ft.	sq. ft.	sq. ft.	sq. ft.
glass				sq. ft.	sq. ft.	sq. ft.	sq. ft.
outside door				sq. ft.	sq. ft.	sq. ft.	sq. ft.
net outside wall				sq. ft.	sq. ft.	sq. ft.	sq. ft.
ceiling				sq. ft.	sq. ft.	sq. ft.	sq. ft.
floor	joist			sq. ft.	sq. ft.	sq. ft.	sq. ft.
	slab			lin. ft.	lin. ft.	lin. ft.	lin. ft.
infiltration				sq. ft.	sq. ft.	sq. ft.	sq. ft.
calculated in -		☐ watts ☐ btuh		total	total	total	total

basement description		coefficient watts/btuh per sq. ft. per °F TD.	coefficient watts/btuh per sq. ft. for 75 °F TD.	room - BASEMENT L 37.7' W 30' H heat loss in watts/btuh	room - L W H heat loss in watts/btuh	room - L W H heat loss in watts/btuh	room - L W H heat loss in watts/btuh
gross outside wall	above gr.			127 sq. ft.	sq. ft.	sq. ft.	sq. ft.
	below gr.			635 sq. ft.	sq. ft.	sq. ft.	sq. ft.
glass		0.15	11.3	14 sq. ft. 158	sq. ft.	sq. ft.	sq. ft.
outside door		-	-	- sq. ft. -	sq. ft.	sq. ft.	sq. ft.
net outside wall	above gr.	.143	10.7	127 sq. ft. 1359	sq. ft.	sq. ft.	sq. ft.
	below gr.	-	1.2	635 sq. ft. 762	sq. ft.	sq. ft.	sq. ft.
floor	slab	-	0.6	454 sq. ft. 272	sq. ft.	sq. ft.	sq. ft.
	perimeter	-	-	- lin. ft. -	lin. ft.	lin. ft.	lin. ft.
infiltration 36 AC/HR		.0053	0.4	3734 sq. ft. 1090	sq. ft.	sq. ft.	sq. ft.
calculated in -		☑ watts ☐ btuh		total 3641	total	total	total

prepared by	date	plan identification	heating est. number or file number
C. CAMPBELL	SEPT 29/81		CIS-3319

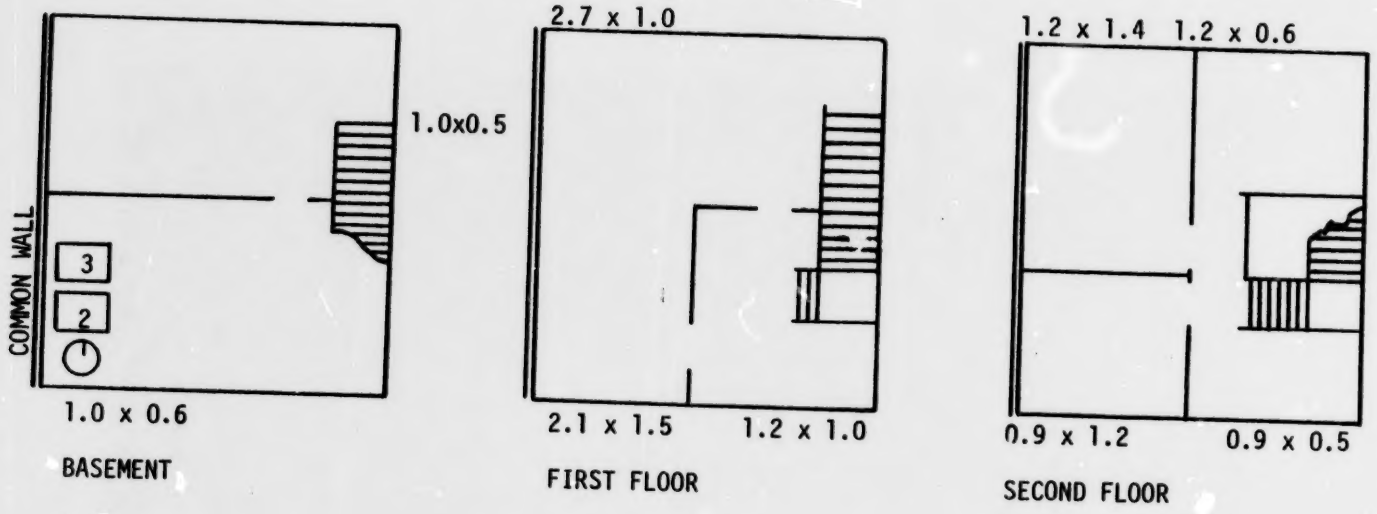
ILLUSTRATION 2

FURNACE ROOM SCARBOROUGH



- Gas Water Heater
- Electric Furnace
- Gas Furnace

FIGURE 3: FLOOR PLANS (SCARBOROUGH)



1. CONDENSING GAS FURNACE
2. ELECTRIC FURNACE
3. GAS WATER HEATER

SCALE 1:125
DIMENSIONS IN METERS

EACH FLOOR 6.1m x 6.9m
HEATED AREA = 42m^2/FLOOR
TOTAL HEATED FLOOR AREA = 126m^2

N

SCARBOROUGH
CONDENSING FURNACE
FIELD EVALUATION

6.0 MARKHAM TEST SITE

This home is a bungalow with a full basement, and has a total heated area of 284 square meters. The house is of average tightness. Windows are stormed and screened.

A heat loss study was conducted to determine the necessary furnace sizing; see Figures 4 and 5. It was found that an estimated input of 27.60 kw was required.

A Condensing Gas furnace of 23.44 kw rated capacity was selected, as this was the closest capacity furnace available commercially.

The existing electric furnace, rated capacity of 25 kw was utilised as the monitor, thereby eliminating the need to purchase a new electrical furnace.

The furnace was installed during the cold month of January and commenced functional testing in February.

Floor plans of this dwelling are given as Figures 6 and 7.

This site is equipped with an electric water heater.

ILLUSTRATION 3

MARKHAM TEST SITE

TABLE II

GENERAL INFORMATION

Name of occupant Company Employee

Installation address Markham

Single Family Residence? X Multiple? _____

Approx. age of structure 9 years How long have you resided? 2 years

No. of occupants 3 Adults 2 How many are employed 2

If two or more, which hours 8:30 - 4:30

What indoor temperatures do you maintain:

While at work 22° Hours _____

Daytime 22° Hours _____

Nighttime 22° Hours _____

STRUCTURE

Do you have a basement Yes Is it heated Yes

Number of stories 1

Type of construction (Brick of frame) Brick

Does it have storm windows Yes Storm doors Yes

Is it insulated Yes Was any insulation installed recently _____

If so, when - Where, and thickness _____ Type Fibreglas

In your opinion, is building of tight construction Yes

No. of basement windows 7 Do they close tightly Yes

Is the door to the basement normally closed No

No. of exhaust fans: Kitchen 1 Bathroom 2 Other _____

Where is thermostat located (room) Hall Inside or Outside wall Inside

Does this house have a fireplace Yes Does it have a good damper Yes

How often is it used? _____

Chimney height _____ No. of flues _____ Internal dia. of each flue _____

No. of openings in chimney _____

Does it have a cleanout door inside or outside _____

APPLIANCES

Does this residence have a gas light No

Input or number of mantles _____

Does this residence have an electric or gas range Electric

If gas: Type _____ Location _____

If more than one, type _____ Location _____

Does this residence have a gas grill Yes outside

Hourly inputs _____ How often is it used _____

Does this residence have a gas or electric clothes dryer Electric

If gas: Location _____ Vented to outdoors? _____

Size of vent pipe _____ Hourly input _____

How often is it used _____

Does this residence have a gas fired water heater No

Storage capacity _____ Hourly input _____

Size of flue pipe _____ Does this pipe connect to the same chimney as the heating system. _____

Does this residence have air conditioning Yes

Central X Window units _____ How many? _____

HEATING SYSTEM

Present Furnace.

Trade Name Chromolox Electric Furnace

Model HAF 225-2

Manufacturer Chromolox

Rated Input 25 kw

Age 9 years

Type of Ignition _____

Type of Venting _____

Test Furnace.

Trade Name Clare Megasave I

Model HEG 80

Manufacturer Clare Brothers

Rated Input 23.44 kw

Age New

Type of Ignition Spark to Pilot

Type of Venting P.V.C. Pipe

Figure 4 - Heat Loss Study - Markham

copy for:-

ONTARIO ELECTRICAL LEAGUE

heating and cooling installation record

note: this is not a contract: any amounts stated herein are estimates only and are subject to change without notice.

☐ new ☑ conversion | specification for ☑ heating ☐ cooling | date SEPT 29/81

submitted for: MR F. DIXON | submitted by: CONSUMERS GAS CO.

location of installation: 9 THURGATE CRES. MARKHAM | address: 500 CONSUMERS RD. NORTH YORK | phone number: 492-5883

power supply authority | address | phone number

estimated annual heating consumption Btu kwh | estimate based on details submitted and:- | heated area 2940 sq. ft. | cooled area sq. ft. | ☐ to Ontario Building Code

annual heating cost estimated at ¢/kwh | degree days | c factor | ☑ other conditions list.

inside design temp. heating 72°F cooling | outside design temp. heating -3°F cooling

remarks:
CEILING :- R20 INSULATION
WALLS :- SOLID MASONRY
BASMT WALL :- UNINSULATED
DOORS & WINDOWS :- STORMED, DOUBLE GLAZED.

and heating-cooling each room to the following requirement note: shaded area for use of inspection only.

room or area name and identify carefully	cooling min. Btuh	heating min. watts required	heating installed watts or Btuh	room or area name and identify carefully	cooling min. Btuh	heating min. watts required	heating installed watts or Btuh
1ST. FLOOR		6,537					
BASMT		10,959					

RE: THESE COPIES FOR ELECTRICAL CONTRACTOR

type of system: ☐ cable ☐ hydronic ☐ baseboard ☐ heat pump ☐ central warm air ☐ other (state)

installed cooling capacity | totals ▶ | 17,601 | as per O.B.C.

Notify power supply authority and the original calculator of changes in details submitted as they could affect heating consumption and installed capacity.

installed capacity approval
inspected by
date | inspection order no.

prepared by: C. [illegible] ONTARIO ELECTRICAL LEAGUE CERTIFIED CALCULATOR

approved by: [illegible] O.E.L. representative

reference: C15-3248

Figure 5 - Heat Loss Study - Markham

THE ONTARIO ELECTRICAL LEAGUE

2940 ft² 27,601 cu ft

HEAT LOAD CALCULATION WORK SHEET

description		coefficient: watts/btuh per sq. ft. per °F TD.	coefficient: watts/btuh per sq. ft. for ... °F TD.	room - 1ST FLOOR: L 43' W 38' H 8' / heat loss in watts/btuh	room - : L / W / H / heat loss in watts/btuh	room - : L / W / H / heat loss in watts/btuh	room - : L / W / H / heat loss in watts/btuh
gross outside wall				1381 sq. ft.	sq. ft.	sq. ft.	sq. ft.
glass		0.15	11.3	290 sq. ft. / 3186	sq. ft.	sq. ft.	sq. ft.
outside door		.079	5.9	42 sq. ft. / 318	sq. ft.	sq. ft.	sq. ft.
net outside wall		.068	4.6	1119 sq. ft. / 7385	sq. ft.	sq. ft.	sq. ft.
ceiling	R30	.016	1.2	1470 sq. ft. / 1764	sq. ft.	sq. ft.	sq. ft.
floor	joist	-	-	- sq. ft. / -	sq. ft.	sq. ft.	sq. ft.
	slab	-	-	- lin. ft. / -	lin. ft.	lin. ft.	lin. ft.
infiltration	1 ac/HE	.0053	0.4	11,760 sq. ft. / 1764	sq. ft.	sq. ft.	sq. ft.
calculated in -		☑ watts ☐ btuh		total / 16,587	total	total	total

description		coefficient: watts/btuh per sq. ft. per °F TD.	coefficient: watts/btuh per sq. ft. for ... °F TD.	room - : L / W / H / heat loss in watts/btuh	room - : L / W / H / heat loss in watts/btuh	room - : L / W / H / heat loss in watts/btuh	room - : L / W / H / heat loss in watts/btuh
gross outside wall				sq. ft.	sq. ft.	sq. ft.	sq. ft.
glass				sq. ft.	sq. ft.	sq. ft.	sq. ft.
outside door				sq. ft.	sq. ft.	sq. ft.	sq. ft.
net outside wall				sq. ft.	sq. ft.	sq. ft.	sq. ft.
ceiling				sq. ft.	sq. ft.	sq. ft.	sq. ft.
floor	joist			sq. ft.	sq. ft.	sq. ft.	sq. ft.
	slab			lin. ft.	lin. ft.	lin. ft.	lin. ft.
infiltration				sq. ft.	sq. ft.	sq. ft.	sq. ft.
calculated in -		☐ watts ☐ btuh		total	total	total	total

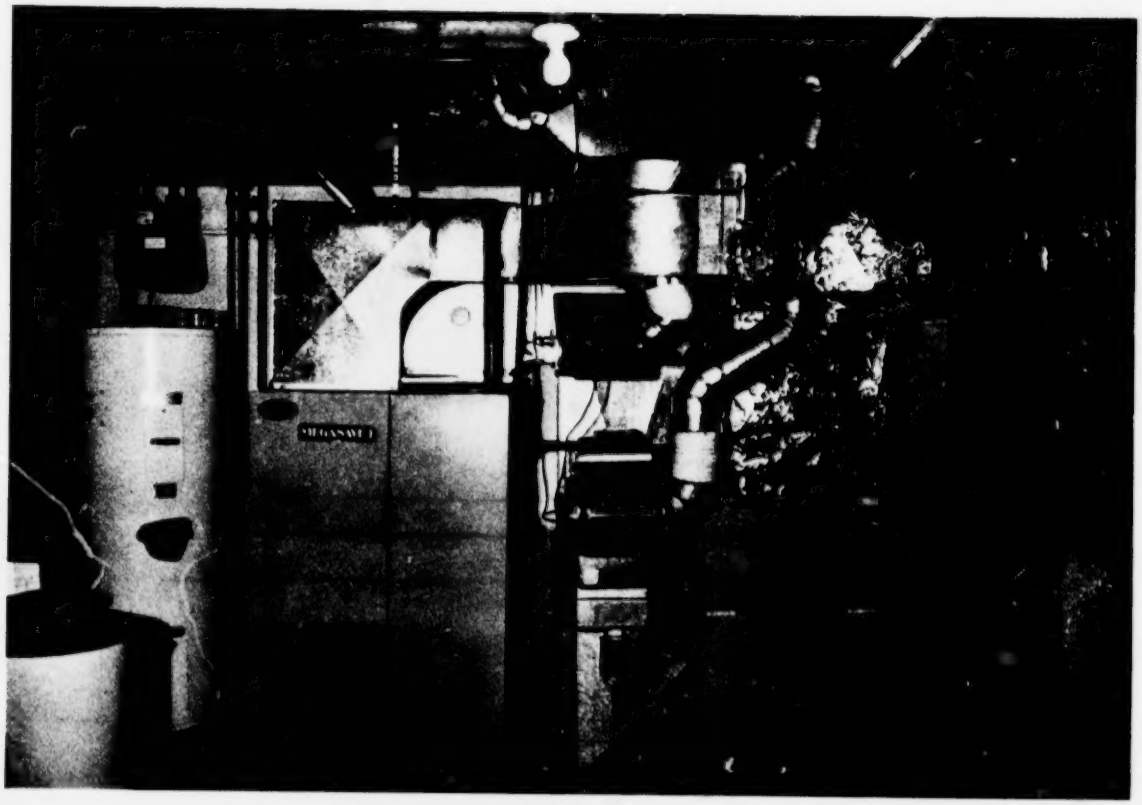
description		coefficient: watts/btuh per sq. ft. per °F TD.	coefficient: watts/btuh per sq. ft. for ... °F TD.	room - : L / W / H / heat loss in watts/btuh	room - : L / W / H / heat loss in watts/btuh	room - : L / W / H / heat loss in watts/btuh	room : L / W / H / heat loss in watts/btuh
gross outside wall				sq. ft.	sq. ft.	sq. ft.	sq. ft.
glass				sq. ft.	sq. ft.	sq. ft.	sq. ft.
outside door				sq. ft.	sq. ft.	sq. ft.	sq. ft.
net outside wall				sq. ft.	sq. ft.	sq. ft.	sq. ft.
ceiling				sq. ft.	sq. ft.	sq. ft.	sq. ft.
floor	joist			sq. ft.	sq. ft.	sq. ft.	sq. ft.
	slab			lin. ft.	lin. ft.	lin. ft.	lin. ft.
infiltration				sq. ft.	sq. ft.	sq. ft.	sq. ft.
calculated in -		☐ watts ☐ btuh		total	total	total	total

basement	description		coefficient: watts/btuh per sq. ft. per °F TD.	coefficient: watts/btuh per sq. ft. for ... °F TD.	room - BASEMENT: L 43.8' W 37.8' H 3'/5' / heat loss in watts/btuh	room - : L / W / H / heat loss in watts/btuh	room - : L / W / H / heat loss in watts/btuh	room - : L / W / H / heat loss in watts/btuh
gross outside wall	above gr.				518 sq. ft.	sq. ft.	sq. ft.	sq. ft.
	below gr.				863 sq. ft.	sq. ft.	sq. ft.	sq. ft.
glass			0.17	11.3	42 sq. ft. / 475	sq. ft.	sq. ft.	sq. ft.
outside door				-	- sq. ft. / -	sq. ft.	sq. ft.	sq. ft.
net outside wall	above gr.		.43	10.7	476 sq. ft. / 5093	sq. ft.	sq. ft.	sq. ft.
	below gr.		-	1.2	863 sq. ft. / 1036	sq. ft.	sq. ft.	sq. ft.
floor	slab		-	0.6	1570 sq. ft. / 882	sq. ft.	sq. ft.	sq. ft.
	perimeter		-	-	- lin. ft. / -	lin. ft.	lin. ft.	lin. ft.
infiltration	2 1/2 ac/HE		.0063	0.4	8820 sq. ft. / 3528	sq. ft.	sq. ft.	sq. ft.
calculated in -			☑ watts ☐ btuh		total / 11,014	total	total	total

prepared by	date	plan identification	heating est. number or file number
C CAMPBELL	SEPT 27/81		C13-5218

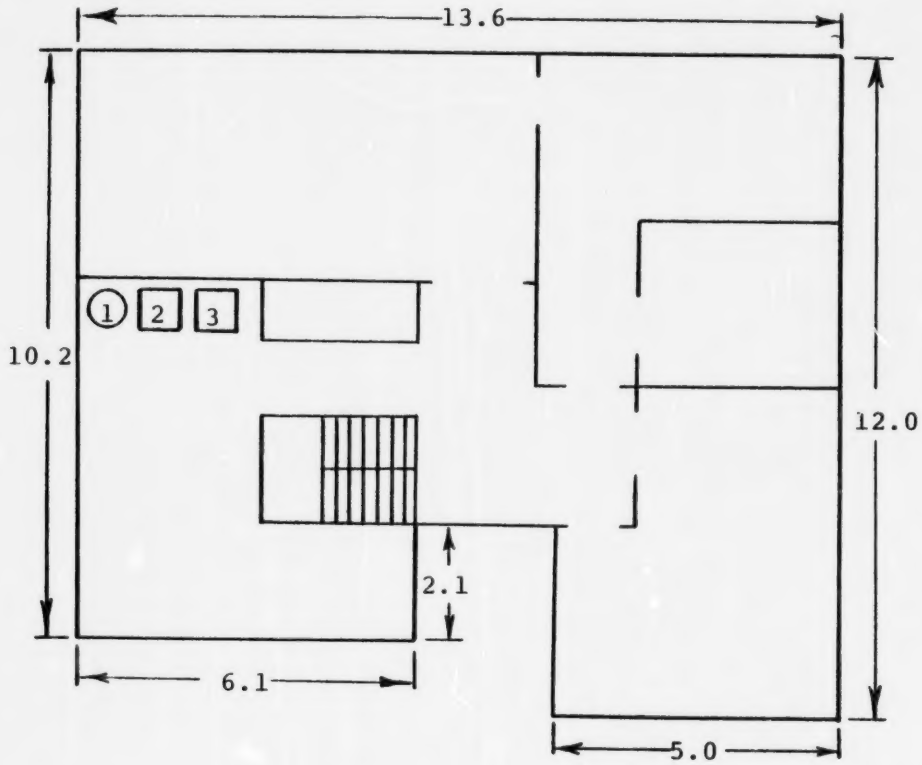
ILLUSTRATION 4

MARKHAM FURNACE ROOM



- Electric Water Heater
- Condensing Gas Furnace
- Existing Electric Furnace

FIGURE 6 FLOOR PLAN: MAIN FLOOR (MARKHAM)



1. Electric Water Heater
2. Condensing Gas Furnace
3. Electric Furnace

- Basement -

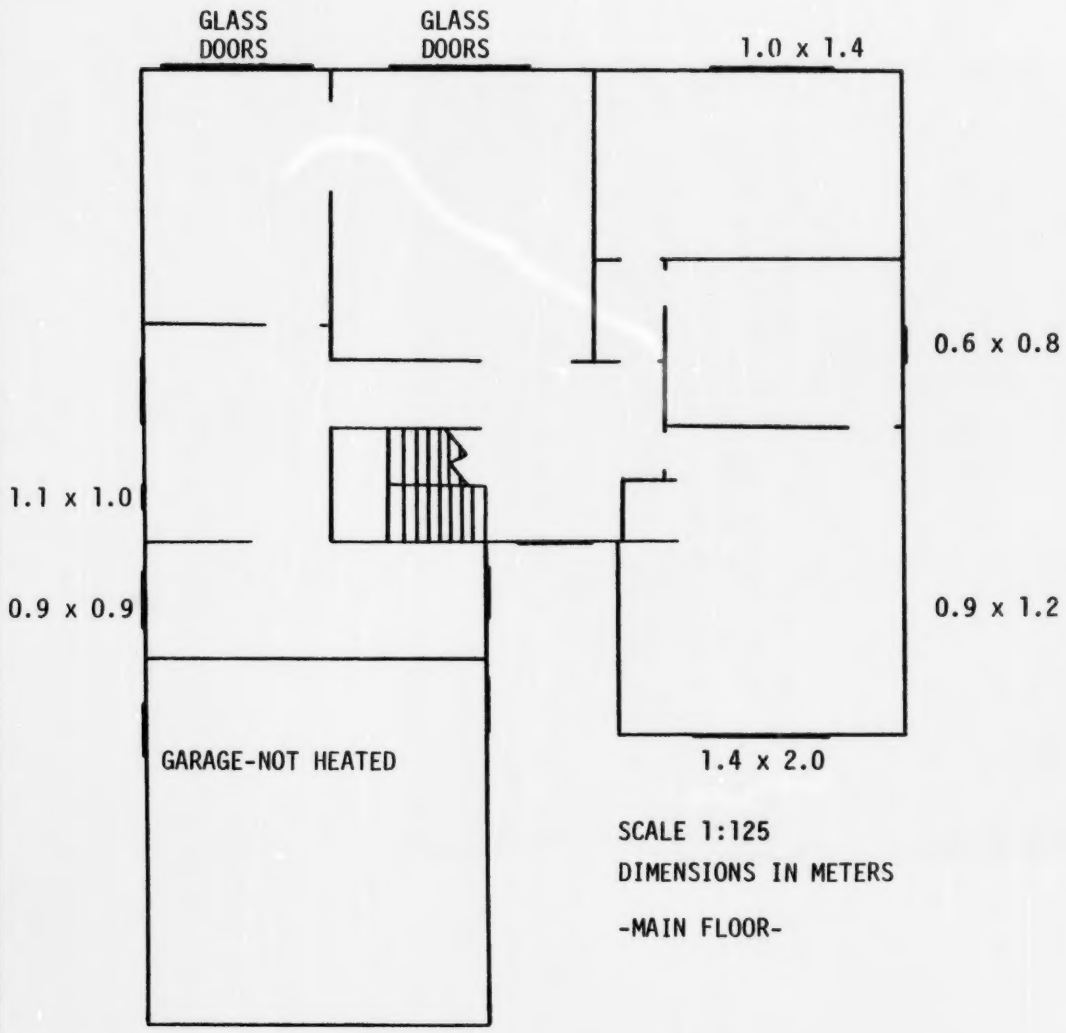
Scale: 1:125

Dimensions In Meters

Heated Floor Area = 14.2 m^2

MARKHAM:
CONDENSING FURNACE:
FIELD EVALUATION:

FIGURE 7: FLOOR PLAN BASEMENT (MARKHAM)



HEATED FLOOR AREA = 142m^2

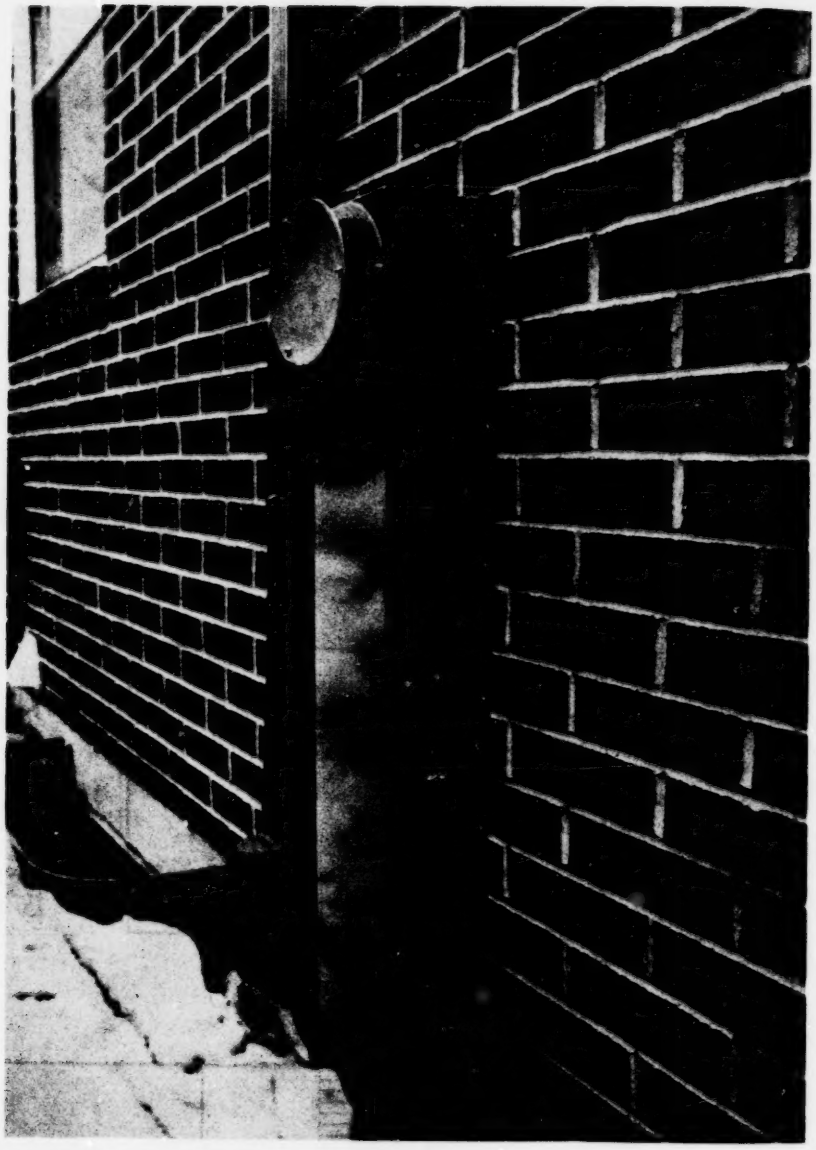
SCALE 1:125

DIMENSIONS IN METERS

-MAIN FLOOR-

MARKHAM
CONDENSING FURNACE
FIELD EVALUATION

ILLUSTRATION 5



FLUE TERMINAL MARKHAM

7.0 COMMISSIONING TRIALS DATA

During the installation of the units, several tests were undertaken to determine general operating characteristics and performance.

7.1 Actual Inputs

Condensing Units	Rated Input kw	Actual Input kw
Model 'A'	17.58	18.00
Model 'B'	23.44	23.34

The actual inputs for the gas furnaces are calculated by a timed dial test on the gas meter.

7.2 Fuel Combustion Efficiency

A partial analysis was conducted on the flue gases at both sites. Results are tabulated below.

Quantity	Model 'A'	Model 'B'
Outside Temperature	1°C	1°C
Room Temperature	20°C	19°C
Flue gas temperature	25°C	44°C
Flue gas analysis		
Carbon Monoxide (0) ppm	10	10
Nitrous Fumes (NO_x) ppm	15	35
Oxygen (O_2) %	12.9	9.8
Calculated Combustion efficiency	87.7%	86.1%

NOTE: The calculation of combustion efficiency does not account for latent heat obtained from condensation of the flue products.

7.3 Condensate Acidity

Condensate samples were taken with the gas furnaces operating at steady state conditions. Condensate was collected at points before and after the optional treatment bottle installed on the test units. Results are tabulated on next page:

Condensing units	PH of untreated condensate	PH of treated condensate
Model 'A'	3.95	9.40
Model 'B'	4.05	9.50

7.4 Volumetric Rate of Condensation

The rate of condensation of flue products was measured in the gas furnaces. Readings were taken at steady state conditions.

Condensing Units	L/hr.
Model 'A'	0.648
Model 'B'	1.774

8.0 CHANGE OVER PROCEDURE

Both furnaces were installed with blade type gates in supply and return air to each furnace. This allows each furnace to be isolated for functional testing.

At both sites the same thermostat is used to control both the gas and electric furnaces. Operation of these thermostats is changed from furnace to furnace by a simple switch.

Whilst it is realized that there will be a difference due to the anticipator setting by using the same thermostat to control both furnaces, the inherent droop effect and the calibration will be the same for both, and it is felt that this situation is better than using two individual thermostats with different characteristics.

Complete change over procedures are given in tables III and IV.

TABLE III

GAS SWITCHOVER PROCEDURE

Scarborough

A. From Gas to Electric

1) Pull both blade switches to central (off) position.

2) If furnace is running, wait until the blower stops. This may take up to 12 minutes.

3) Switch off gas furnace. Switch is located above gas furnace.

4) Remove gates from supply and return ducts for the electric furnace.

5) Insert gates into supply and return ducts for the gas furnace.

6) Pull both blade switches into "electric" position.

B. From Electric to Gas

1) Pull both blade switches to central (off) position. Switches are located on the common air supply to both furnaces by the gas submeter.

2) If the furnace is running, wait until blower stops. This may take up to 2 minutes.

3) Remove gates from supply and return ducts for the gas furnace.

4) Insert gates into supply and return ducts for the electric furnace.

5) Push both blade switches to "Clare" position.

6) Switch on gas furnace. Switch is located above furnace.

GAS SWITCHOVER PROCEDURE

Markham

A. From Gas to Electric

1) Pull both blade switches to central (off) position.

2) If furnace is running, wait until blower stops. This may take up to 12 minutes.

3) Switch off gas furnace (switch is located on beam above gas furnace).

4) Remove lower gate (allows cool air return to electric furnace).

5) Insert upper gate (closes hot air duct from gas furnace).

6) Pull both blade switches up to "electric" position.

B. From Electric to Gas

1) Pull both blade switches to central (off) position.

2) If furnace is running, wait until blower stops. This may take up to 2 minutes.

3) Remove upper gate (opens hot air duct from gas furnace).

4) Insert lower gate (closes return to electric furnace).

5) Switch on gas furnace (switch is located on beam above gas furnace).

6) Pull both blade switches down into "Clare" position.

9.0 INTERIM COMMENTS ON INSTALLATION

- The unit appears to be well designed but can present handling difficulties due to its large size.

- No functional or installation problems were experienced with these Condensing Gas units.

- A variety of minor difficulties were experienced with the test instrumentation but these have been resolved satisfactorily.

- The vent terminal appears to disperse combustion products in an acceptable manner, although a condensate icicle forms below the terminal plate during cold weather.